Space Weather Technical Forecast

Issued on Wednesday, 18 May 2022 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of R1-R2 radio blackouts.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate over the past 24 hours, with an M1.0 flare which peaked at 06/1145 UTC by GOES-17 (C9.9 by GOES-16) from AR2014 (Dkc/Beta-Gamma-Delta). This is currently the most notable sunspot group, with recent growth and a small delta area appearing to the north of the leading spot. AR3007 Esi/Beta is another region of note, being moderately sized, and also the only one in the southwest, but is now showing signs of fading slightly. All other regions are relatively simple at this time. A CME was observed in coronagraph imagery, likely from AR3015, and this has been assessed as probably passing behind Earth's orbit. There is low confidence however, and a glancing blow is possible on 20 May. No other Earth directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, shows signs of a high speed stream enhancement. Wind speeds rose from just below 500 km/s, to reach 550-600 km/s. The density has been mainly average or below average. The Interplanetary Magnetic Field, Bt, was mainly weak, but showed moderate peaks up to 11nT between 17/0230-0930 UTC. The north-south component, Bz, mostly varied weakly, but occasionally moderately between +11/-8nT, with a slight positive bias. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has remained mostly at background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu) threshold on a level trend. Observed fluence at 18/0000 UTC was 1.47e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is likely to remain at Low to Moderate levels, with an ongoing chance of M-class flares, and a Slight Chance of an X-class flare.

Solar Wind / Geomagnetic Activity: A weak CME was observed which could have originated from AR3015 at 17/0510 UTC. This has been assessed as most likely passing behind Earth's orbit on 20 May, but may give a glancing blow. Confidence is very low, however.
Solar winds are currently elevated with Earth apparently in a high speed stream from a positive polarity coronal hole. It is difficult to be sure of the exact source for this. However, solar winds are likely to be elevated through much of this forecast period, perhaps with a slight dip during Day 1 (18 May) before rising again later Day 1 or early Day 2 (19 May). Geomagnetic activity is expected to be largely Quiet to Unsettled. If we do see a brief dip in wind speeds followed by a further high speed stream, or if we do see the CME on Day 3 (20 May), then Unsettled to Active spells are possible with a slight chance of a G1/Minor Storm interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is

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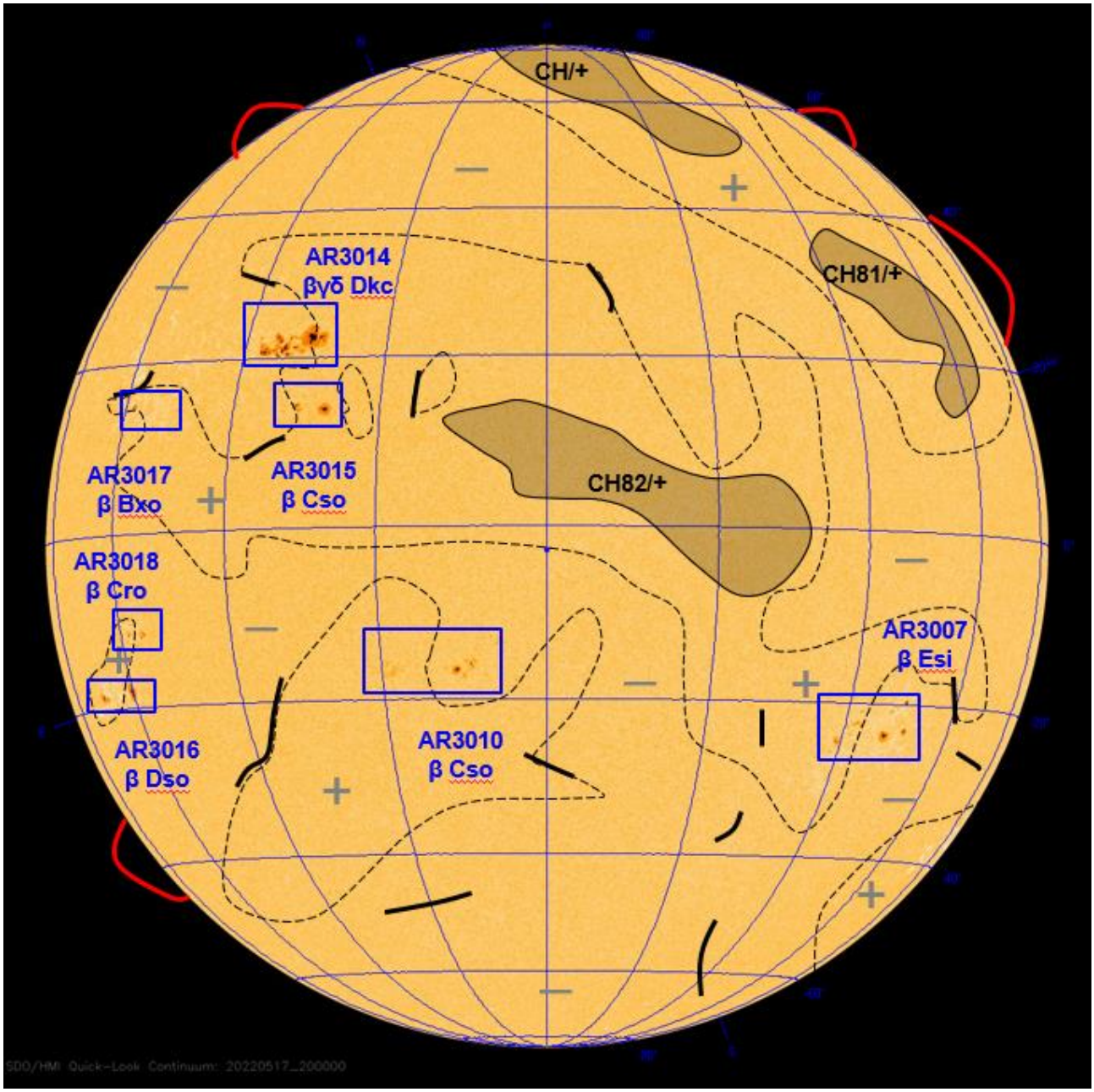
expected to be at background levels during this period, but with a very slight chance of flux reaching above S1, should any notable flares occur, primarily from AR3007 and AR3014. The high energy electron flux (greater than 2 MeV) is forecast to remain at background levels at first, but may rise over the next few days, with an increased chance of the diurnal peak reaching High levels later in the period due to fast wind effects. The 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold during the forecast period, perhaps on a rising trend.

Figure 1. Solar Analysis Valid 17/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A weak CME observed in coronagraph imagery during 17 May could have originated from AR3015 at 17/0510 UTC. This has been assessed as most likely passing behind Earth's orbit on 20 May, however the assessment of the CME was difficult and confidence is very low. As such, there is just a very slight chance of a glancing blow from this feature on 20 May.

Solar winds are currently elevated with Earth apparently in a high speed stream from a positive polarity coronal hole. This may be a continuation of CH81, although this had appeared to start to ease, but alternatively it could be an early arrival of CH82. This is an equatorial hole, and significantly more westward extended than on the previous rotation. Although in AIA-193 imagery it doesn't appear to be in a geoeffective position yet, analysis of AIA-211 imagery suggests a diffuse leading edge further west still and therefore possibly could be the feature we are currently experiencing. As such, solar winds are likely to be elevated through much of this forecast period, perhaps with a slight dip during Day 1 (18 May) before rising again later Day 1 or early Day 2 (19 May) if we are yet to see CH82.

Geomagnetic activity is expected to be largely Quiet to Unsettled. If we do see a brief dip in wind speeds followed by the arrival of CH82, or if we do see the CME on Day 3 (20 May), then Unsettled to Active spells are possible with a slight chance of a G1/Minor Storm interval.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/0957	Partial	Possibly AR3015	NE quadrant	456 km/s	20/1200 UTC	Likely miss. Very low confidence glancing blow.

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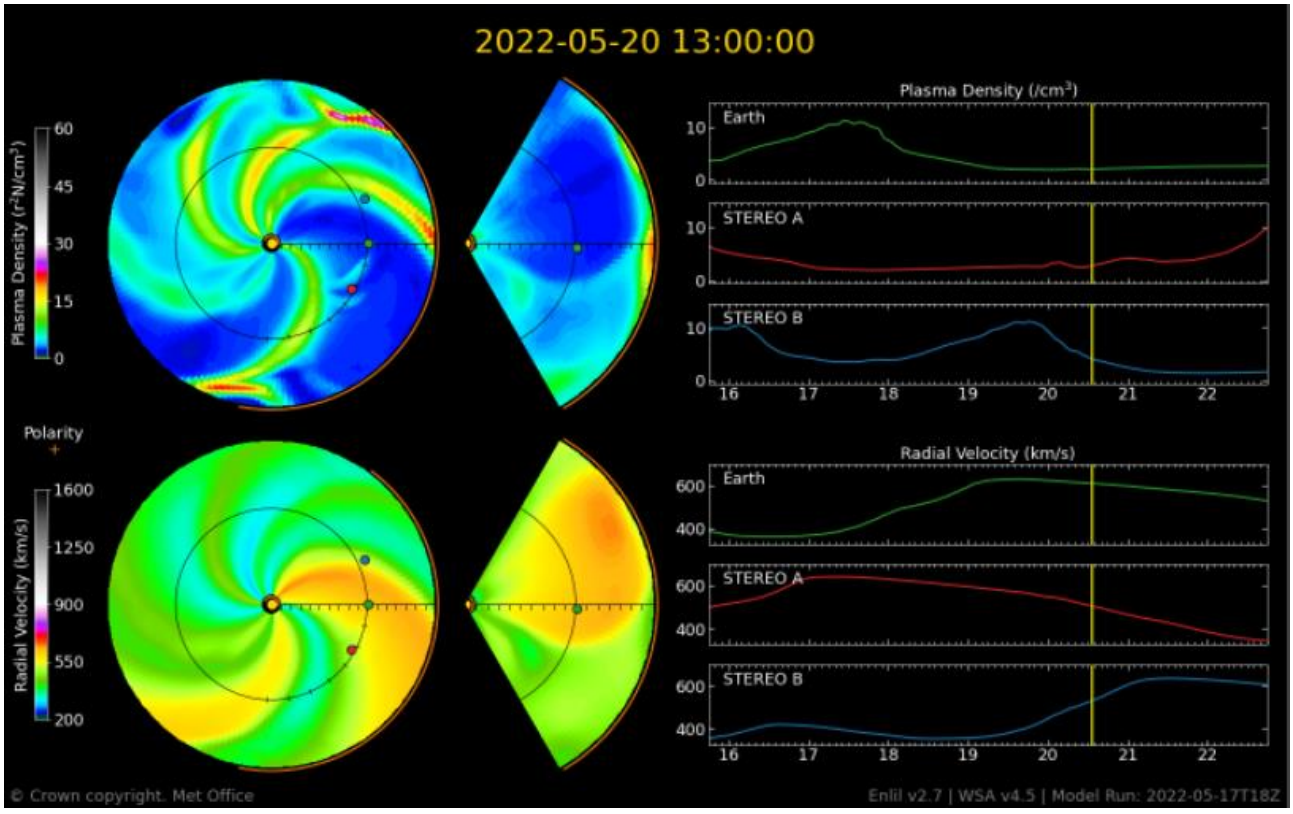
Figure 2: Enlil model showing weak CME passing behind Earth's orbit.



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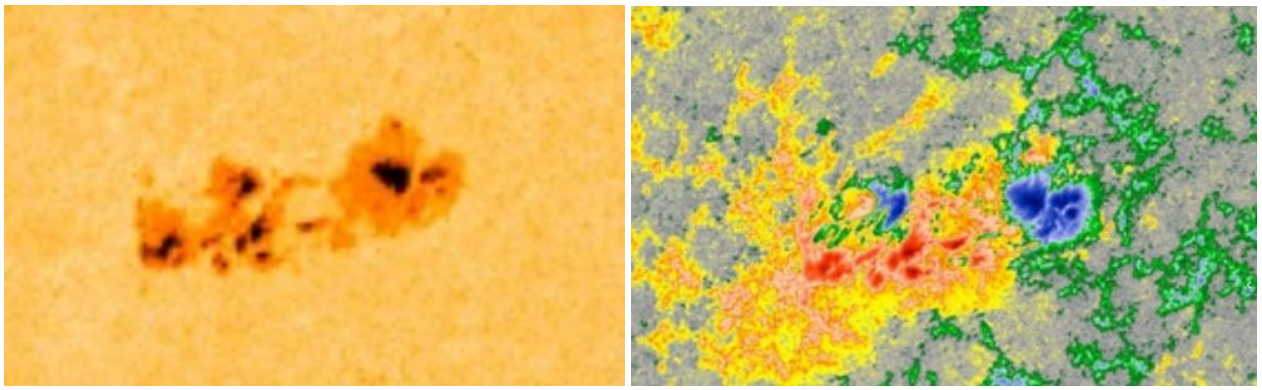
Radio Blackouts - X-Ray Flares:
Solar Activity is currently Moderate with an M1.0 flare peaking at 17/1145 UTC. There are seven numbered sunspot regions on the visible disc.

The most notable region is AR3014 (Dkc/Beta-Gamma-Delta), one of a number of spots in the northeast disc. This region has exhibited some growth in the last 24 hours, with some complexity developing to its magnetic structure, increasing the flare risk from this region. AR3007 (Esi/Beta) is the other moderately sized region, and the only one currently located in the southwest, however this has been slowly fading. The other regions are generally smaller and simpler, although this does not preclude flaring from one of these regions.

Overall, this gives a chance of further M-class flares (R1-R2 Radio blackouts), with activity expected to be Low to Moderate. There is a slight chance of an isolated X-class flare (R3 Radio Blackout).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: AR3014 showing a small delta (opposite polarity) area in the north of the leading spot.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at that level throughout the period. However, there is a slight chance of an S1 or greater event during the forecast period, partly due to AR3007 as it transits towards the western limb of the visible disc. However, as the complexity of AR3014 has increased so the risk of a proton event from this feature has also slightly increased, with this becoming slightly higher towards the end of the period as it transits westwards.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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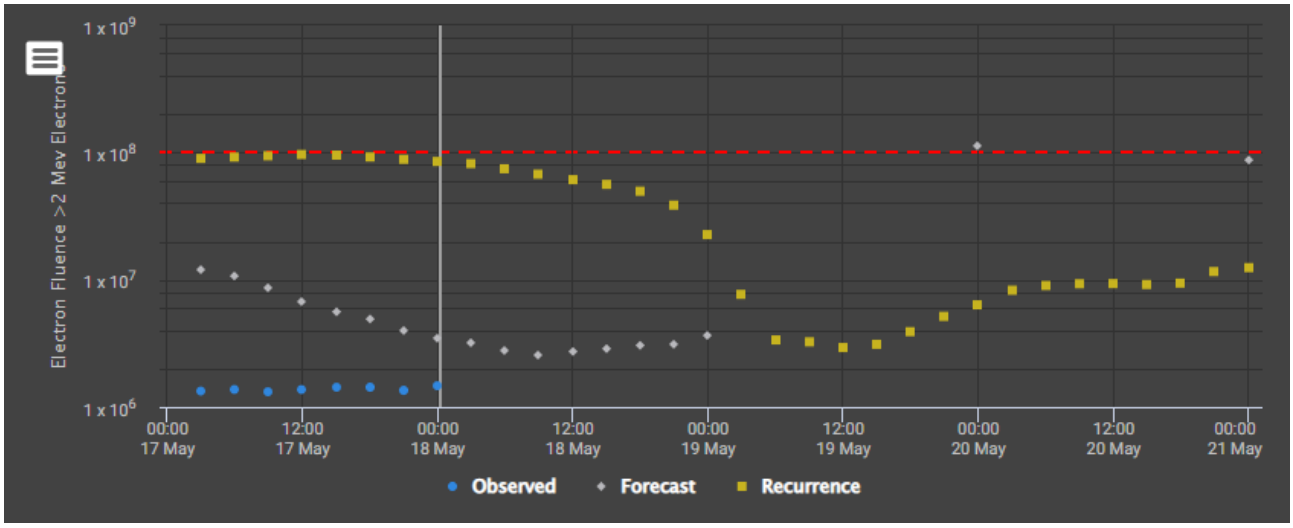
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO is currently at background levels, but may rise to Moderate levels over the next few days due to fast wind influences from CH81 and CH82. This perhaps giving a chance of flux levels reaching High (1000 pfu) levels later in the period.

The corresponding electron fluence is therefore expected to show an upward trend through the period, however on balance will most likely continue below the Active (1e8 integrated pfu) threshold. This is reflected by current REFM output, which suggests a rise below the Active level on Days 2 and 3 (19-20 May).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM model showing a possible rising trend on Days 2 and 3, but likely to remain below the Active threshold.

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.



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